Abstract Submitted
for the NWS15 Meeting of
The American Physical Society

Energy spectrum and spin structure of harmonically trapped one-dimensional atoms with spin-orbit coupling[1] QINGZE GUAN, DOERTE BLUME, Washington State University — Ultracold atomic gases provide a novel platform with which to study spin-orbit coupling, a mechanism that plays a central role in the nuclear shell model, atomic fine structure and two-dimensional electron gases. We introduce a theoretical framework that allows for the efficient determination of the energy spectrum and spin structure of harmonically trapped atoms with zero-range interactions subject to an equal mixture of Rashba and Dresselhaus spin-orbit coupling created through Raman coupling of atomic hyperfine states. The spin structure of bosonic and fermonic two-particle systems with finite and infinite interaction strength g is calculated. Taking advantage of the fact that the N-boson and N-fermion systems with infinitely large coupling strength g are analytically solvable for vanishing spin-orbit coupling strength k_{so} and vanishing Raman coupling strength Ω, we develop an effective spin model that is accurate to second-order in Ω for any k_{so} and infinite g. The three- and four-particle systems are considered explicitly. It is shown that the effective spin Hamiltonian describes the transitions that these systems undergo with the change of k_{so} as a competition between independent spin dynamics and nearest-neighbor spin interactions.

[1]Support by the NSF is gratefully acknowledged

Qingze Guan
Washington State University

Date submitted: 06 Apr 2015 Electronic form version 1.4